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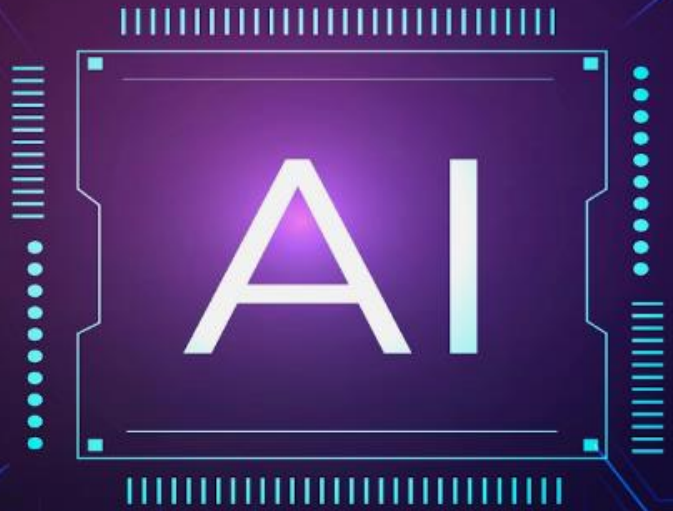

Case Study

Enhancing Shoulder Bone Detection in Surgery Simulation Using Deep Learning: Phase 1

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About the Client

Our client is a pioneering Health Care Tech Start-up headquartered in the USA, specializing in Orthopaedics and Bone Implants research.

Business Problem

The client's primary challenge revolved around the precise identification of Scapula and Humerus bones within 3D DiCOM images. This process involved the conversion of complex 3D images into 2D representations. The intricacies emerged due to variations in bone positions, overlaps, and potential instances of multiple bone appearances within a single image.

Solution

To tackle this intricate bone detection problem, our team embarked on a solution-driven approach. Leveraging the power of deep learning algorithms, three primary methodologies were explored: R-CNN (Region Convolutional Neural Network), Mask R-CNN (Mask Region Convolutional Neural Network), and U-Net. The initial focus was on 2D bone detection, followed by plans to advance to 3D object detection.

Implementation

- **Data Preparation:** The 3D DiCOM images were preprocessed and transformed into 2D DICOM images for analysis. This allowed for an easier integration of the deep learning models.
- **Algorithm Evaluation:** The team evaluated three distinct algorithms: R-CNN, Mask R-CNN, and U-Net. The primary goal was to identify which algorithm demonstrated the highest segmentation accuracy for Scapula and Humerus detection.
- **Challenges Addressed:** Detecting overlapping bones and multiple instances of bones in a single image posed significant challenges. The team devised strategies within each algorithm to handle these complexities effectively.
- **Segmentation Accuracy:** Both Mask R-CNN and U-Net exhibited remarkable performance, achieving segmentation accuracies exceeding 90%. This level of accuracy was a pivotal milestone in achieving the client's objectives.

Outcome

Through the application of deep learning models, specifically Mask R-CNN and U-Net, the client's surgical simulation platform achieved remarkable accuracy in detecting Scapula and Humerus bones within 3D DiCOM images. The achieved accuracy rate of 90% was a testament to the effectiveness of the selected methodologies and the dedication of the team involved.

Lessons Learned

This case study highlights the efficacy of deep learning models in the medical field, specifically in orthopaedic research and surgery simulations. It underscores the significance of algorithm selection and adaptation to address complex challenges like bone overlap and multiple bone instances.

Future Opportunities

With the success of accurate bone detection in 2D images, the next logical step is to progress towards a 3D object detection capability. This extension could further enhance surgical simulations and provide invaluable insights for orthopaedic professionals.

By overcoming the complexities of bone detection within surgery simulations, our team contributed to the client's innovative pursuits in orthopaedic research, setting the stage for future advancements in medical technology and patient care.

Technology Used

Python, OpenCV, Tensorflow, Deep Learning using R-CNN & Mask CNN, U-Net

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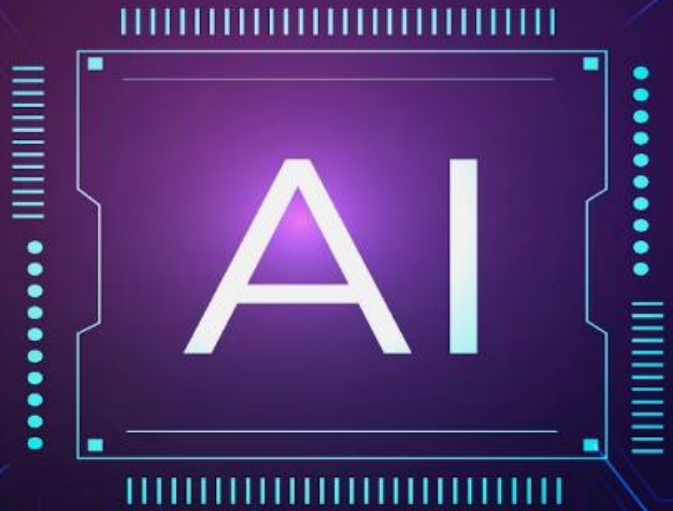

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